

Exchange rate regimes and its impact on growth: An empirical analysis of BRICS countries

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Abstract. *Emerging market economies (EMEs) are increasingly important drivers of global economic growth, as witnessed by the substantial increases in their share of world output during the last four decades. The choice of an exchange rate regime is a recurring issue in international macroeconomics. Recently, the currency crisis in Asia, Russia, Brazil and Argentina has increased interest in this area and the effects of exchange rate regimes become even more important in developing countries. Hence, the purpose of this study is to revisit the effects of exchange rate regimes on Growth of BRICS countries. The data used for this research covers over the period from 1970 to 2012. This study finds that the Pegged exchange rate regimes are not much associated with better performance in terms of growth. In the growth performance, BRICS countries with Pegged regimes show significantly negative growth. Pegged regimes have significantly (-81%) lower growth in BRICS countries. The impact of Pegged regime on growth increases and the positive link between Pegged regimes and GDP growth can occur through a pegged regime's price stability effect. Countries with Pegged regimes have lower real interest rates since pegged regimes act as an anti-inflationary tool for monetary policy makers. Thus, low real interest rates lead to an increase in investment, and in the end, a high level of investment leads to higher levels of economic growth. Moreover, by adopting a pegged regime can promote trade for BRICS countries and lead to an increase in economic growth.*

Keywords: exchange rate regimes, growth models, pegged and non-pegged exchange rates, economic growth, macro economic variables and financial crisis.

JEL Classification: D51, E00, E6, F31, F430, G010.

1. Introduction

The high rate of economic growth is an indispensable factor for deciding the economic development of a nation. The developing countries have procured high growth rate whereas the Less Developed countries have remained in low economic rates. This distinction occurs only after the completion of the Second World War. But in the current period, the situation has been reversed.

Economic Growth is normally defined as a gradual development of per capita national output during specific time period. The growth of a particular nation is decided by the total output which should be higher than that of the nation's population growth. For instance, if an equal growth of nation's output and its population is noticeable at the same time, the per capita income of that nation won't increase. In addition to this, the standard of living remains one and the same. This condition is not good for the economic status of that country. On the other hand, if per capita income increases due to the decline of population growth, it lessens the growth of total output which finally results in the decay of nation's economy. It indicates that the per capita income increases simultaneously with the growth of population.

Another feature of economic growth is that the national output will be satisfied only when there is a maximum number of demand of the people. At the same time sustaining the rate of increase in national output for a long period of time. This is important in making the growth of the economy. In short run increase in output for one period by small increase in it and the next time does not make it. The seasonal, occasional or cyclical increase in output does not satisfy the conditions of sustainable economic growth.

In the light of these facts, the present study deals with affecting factors of growth, sustainable economic growth and also explains the role of pegged exchange rate regime for the better growth performance in the case of BRICS countries.

This study is organized into different sections as follows: Section 2 explains the Literature Review. Section 3 Data and definitions of variables and sample period and data frequency has explained. Section 4 talks about the econometric issues and methodology, theoretical framework and growth model used in this study. Section 5 shows the model estimation and discussion of empirical results. Section 6 ends with summary and conclusion.

2. Literature reviews on growth and exchange rate regime relationship

Alan Ling (2010) examined the aggregate export volumes of nine Western European economies over the period 1980 (Q1) to 1992 (Q4), by using the sample two-regime model. He noticed that there was a co-integration relationship in all cases. Another study done by Amit Ghosh (2014) did as study on choice of exchange rate regimes with comparison between advanced and nations of low-income for 1999 to 2011. He classified regimes into three types and by choosing the fixed exchange rate regimes, he found increases in trade openness, economic development, liabilities of foreign currency. While, in emerging markets the size of economy, concentration of export ratios and financial development become lower. On the other hand, in advanced and low-income nations while choosing the

choice of exchange rate regimes size of land, capital controls and inflation differential significantly influences. In case of emerging markets it was quite opposite.

Andreas Hoffmann (2010) studied on how the growth rate impacted by exchange rate volatility in the case of emerging countries with the Optimum Currency Area framework. The writer employed a panel model which had cross-country and applied on emerging market economies with the data period from 1990-2007. The study found that, the volatility of exchange rate had negative impact on growth. Berdiev et al. (2012) examined on the choice of exchange rate regimes and its effects on globalization. In their study it confirmed that by adopting floating exchange rate regimes globalized countries become higher probability. Another study related to this, which is done by Bosworth (2008) pointed out that in the industrial sector China wants to put remarkable growth which was reduction in trade barriers, and continues encouragement for inflows of Foreign Direct Investment. Whereas, in the case of India by expansion of the service sector the rapid growth was primarily in due. Both the countries are quite different in the sources of their growth.

Dubas (2009) examined the issue of exchange rate regimes choice and how it effect on exchange rate misalignment. For this analysis he was used developing and developed countries. He used the six-way of IMF exchange rate regime classification. He also utilized a panel co-integration vector estimator for 102 countries and for developing countries exchange rate misalignment is matter but not to the developed countries. Firat Demir (2010) analysed on how the employment growth was effected by exchange rate volatility in the case of Turkey. For their analysis the time period covers from 1983-2005. Through the point estimation method, they found that employment growth was reduces by increasing the volatility of real exchange rate. Another related study done by Firat Demir (2013) examined on how growth performance will affects by exchange rate volatility in case of domestic versus foreign one side and another side publicly trade versus non-traded manufacturing firms in Turkey. On manufacturing firms there was a significant growth-reducing impact from exchange rate volatility.

Another study done by Vieira et al. (2013) examined on how the real exchange rate volatility can effect on long-run economic growth. For this analysis, they have used a set of 82 emerging economies and advanced countries with the data period covers form 1970 to 2009. To show the volatility effect on economic growth, they have applied a panel growth model and GMM. They found that, real exchange rate volatility and long-run growth had negative and relevant relation. Another empirical study done by Ghosh et al. (1997) used the IMF declared report for the period 1960 to 1990. In their study, related to exchange rate regimes effects on growth they did not find proper evidence.

Glauco De Vita (2014) investigated on how the international tourism flows affect by exchange rate regimes in the long-run. For this analysis, he used a set of 27 non-OECD and OCED countries for the time period 1980 to 2011. By employing a SYS-GMM, he found that to attract the international tourist, one has to stabilize their exchange rate system. Graham Bird et al. (2009) taken a full sample of developing and emerging countries to examine the relationship between IMF programme and exchange rate regimes. The study covered a twenty-six years, from 1974-2000. They used classifications of *de jure* and *de facto*'s and found there was intermediate are viable and possibly desirable ones.

Husain et al. (2005) analysed the exchange rate regime durability and its performance on developing versus advanced economies over the period of 1970-1999. The study found that pegs are having least durables and exposing countries to higher risks, whereas flexible regimes become more financially developed and become richer. Harris Dellas (2013) focused on the alternative exchange rate regimes implications for asset prices in a frame of portfolio balance model, it was motivated by China-US experience. They found that equity price are stronger under flexible exchange rate regimes.

Ibrahim A. Elbasawi et al. (2012) analysed the linkage between misalignment of exchange rate, foreign aid and economic growth of Sub-Saharan Africa. By employing the GMM estimator they found that overvaluation reduces the growth and, on another hand, the negative effects can be corrected by financial development. Ila Patnaik (2011) empirically analysed on the Asia's exchange rate regimes, from the period of crisis to crisis and found a new way of dollar measuring peg, "the Bretton Woods II Score". The writer concluded that from Bretton Woods II arrangements Asia has moving away. Iulian Ichnatov et al. (2012) studied on Central and Eastern European Countries to see the economic growth and exchange rate regimes relation. To see the exchange rate regimes effects on economic growth, for the growth model they applied an Ordinary Least Square and Generalized Maximum Method and also used dummy variables. The study covers 16 central and Eastern European countries and before the adoption of Euro choice of exchange rate regime is a key point. While comparing growth effects with floating, intermediate regimes and fixed arrangements, it was found that there was a superior effect on economic growth from floating regimes.

Jeannie Bailliu et al. (2002) examined on how the growth impact with the exchange rate arrangements with a panel data set which is consisting of 60 countries from the period 1973 to 1998. They have applied a dynamic generalized method of moment in their study. They found a positive relationship on exchange rate regimes which is characterized by a monetary policy anchor, either they follow pegged, intermediate or flexible. They finally concluded by saying, for any countries economic growth it is important to follow monetary policy framework rather than exchange rate regime. Jean-Pierre Allegret (2014) analysed on how the global imbalance will affected by real exchange rate adjustments. By applying the multilateral approach method with the sample consisting of advanced countries 15 and emerging countries. The writer used quarterly data which is consisting from the period 1980 to 2010 and applied a GVAR model and found that dollar misalignment significantly influence the world economy.

Julian di Giovanni et al. (2012) studied on the role of exchange rate regime and the economy how they affected by foreign interest rates. In the case of domestic economy they found high foreign interest rates have contractionary effects on annual real GDP growth. But, this effect centered on countries which follows fixed exchange rates. There is a possibility that interest rate may affect the trade-off also. Jurgen et al. (2007) examined on developing countries choice in exchange rate regimes since 1980. They focused mainly on fundamentals of Optimum Currency Area, consideration of stabilizing the economy, factors affecting on currency crisis and political factors and features of institutions, by applying simulation-based techniques. It brought out the strong state dependence in

choosing the regimes choice. Karim Barhomi (2005) taken a sample of 24 developing countries with the data period covering from 1980 to 2003 and examined on the import prices and exchange rate pass-through. By applying Pooled Mean group approach. The study found that the variation in import prices and it was duly affected by major macroeconomic determinants. They are, regimes of inflation, exchange rate regimes and trade barriers. Similarly, Levey-Yeyati and Sturzenegger (2000) explored the growth and exchange rate regime relationship. For their study, they used annual data from 1974 to 1999. The major findings were: (a) lower per capita output growth rate are associated with fixed exchange rate regimes. (b) While comparing with nonindustrial and industrial, there was a higher output volatility association with fixed exchange rate regimes with nonindustrial countries than industrial countries.

Ludger Schuknecht (1999) empirically analysed the relationship between exchange rate regime and fiscal policy cycles on 25 developing countries. He applied regression technique with covering of annual data set from 1978 to 1992. He found that by adopting fiscal policies, the governments are try to improve their re-election prospects with fixed exchange rates and adequate reserve levels. Marelli and Signorelli (2011) examined on India and China's trade openness facilities towards economic growth under a panel data set. While, methodological choice wise it is a questionable to apply panel data set on India and China, since both the countries have quite different growth experiences. Muhammad et al. (2013) investigated on energy consumption and economic growth relationship, in the case of China with the data covering from 1970-2011. To see the long-run relationship among the series, he applied co-integration and ARDL test. Their empirical shows that there was a positive impact on economic growth by these variables. Through another test like granger causality, they found international trade and energy use, had a bidirectional causality.

In the light of this, Mundell (1995) also examined the industrial countries growth performance, before and after the Bretton woods. They found that, industrial countries are having faster average growth rates with the association of fixed exchange rate regimes. Philippe Aghion (2009) examined the role of financial development with regards to the exchange rate volatility and productivity growth. He applied GMM dynamic panel data estimator and found that any effect must be depends on countries financial development. Rolnick and Weber (1997) used a set of long-term historical data to find out the output growth rate. While looking into the output growth performance, it confirmed that a higher output growth under first standards than commodity standards like gold. Sarkar (2008) examined on the trade openness and its impact on India's growth, he found it has negative impact. The study considered variables as imports and exports, trade openness and GDP. There are many different measures for Trade openness, while some of them used absolute trade volumes, some studies applied an openness indices which is based on the trade barriers. However, to get the complete picture on this issue we need to apply different measures.

Sebastian Edwards et al. (2005) analysed under the alternative exchange rate regimes, how the economic performance may affect through terms of trade. For analysis he used 183 countries covering with the data period 1974-2000. They employed the growth dynamic

regression model and found that in rigid exchange rate regime countries terms of trade get better response. When comparing with the fixed and flexible exchange rate regimes performance, it shown that there was a faster grow in flexible exchange rate regimes. Simon Sosvilla-Rivero et al. (2014) empirically analysed relationship between economic growth and exchange rate regimes for 123 countries. In their analysis they found that under intermediate exchange rate regimes, the growth performance is best while the smallest growth rates are associated with flexible exchange rates.

Taro Esaka (2013) empirically examined the treatment effect of *de facto* pegged regimes and the currency crisis occurrence on 84 nations from the period 1980 to 2001. By employing average treatment effects, the writer brought two major issues regarding pegged regimes: (a) the likelihood of currency crisis significantly decreases in pegged exchange rate regimes while comparing with floating regimes, and (b) regarding capital account liberalization, the likelihood of currency crisis become lower comparing with other regimes. Finally, it was concluded that on speculative attacks substantially less with capital account liberalization in the pegged regimes. It was due to their strict discipline in their monetary and macroeconomic policies. Unay Tamgac (2013) examined whether the duration of any exchange rate regime had any effect on emerging economies. By applying the classification of Rainhart and Rogoff (2004), he found that for pegged regimes, change in foreign reserves, misalignment of real exchange rate, growth, trade openness are influenced by the duration.

Virginie et al. (2005) examined on inflation and growth are affecting by exchange rate regimes for the Asian Countries for the period 1990:01-2001:04. They used the *de facto* classification of four categories. They found floating regimes are associated higher growth than pegs, whereas inflation was questionable, due to bias in endogeneity. Walid Chkili et al. (2014) investigated on BRICS countries to see the linkage between stock market returns and exchange rates, by using regime switching model approach. The data period covers on weekly stock prices and exchange rates of US dollar on BRICS countries taken up from March 1997 to February 2013. During periods of turbulent and calm, they found exchange rate are more influenced by stock markets.

Prior studies in the field which was provided by the earlier studies are in the mixed view on currency crisis occurrence impacted by exchange rate regimes. The studies are useful in judging, examining and drawing conclusions about the exchange rate regimes types that were useful to maintain a sustainable growth in BRICS countries and in fining what type regime can avoid currency crisis.

Table 1. Summary-table of the empirical research of the exchange-rate regime effect on growth

Study	Data and period of sample(s)	Exchange Rate arrangement	Model used in their study	Method	Outcomes with Peg and Growth	Problems
Bailliu et al. (2003)	From 1973 to 1998, sample of 60 countries	Both <i>de facto</i> and <i>de-jure</i> were applied, but the latter part added important in terms of findings	Applied a Real per capita growth method	Generalized Method of Moments	It was positive relation Any monetary anchor positively effects on growth when it was exercised by Exchange rate regimes, or else, Exchange Rate Regime other than peg destructs growth	It was weak on robustness check
Bleaney and Francisco (2007)	From 1984 to 2001, considered 91 developing countries	<i>De facto</i>	Applied a growth model	Ordinary Least Squared	Negative Growth was slower under more rigid exchange-rate regime	There was a weak in specification; not preserved for endogeneity; didn't check robustness
De Grauwe and Schnabl (2004)	From 1994 to 2002, 10 CEE countries	<i>De facto</i>	Applied a Real growth analysis	Generalized Method of Moments	It was positive relation It confines that for reducing economic growth Pegged doesn't fit.	Short time period and small sample
Domac et al. (2004)	10 years; considered only on twenty two transition countries	<i>De jure</i>	Applied a growth model	Switched towards technique of regression	Results are Inconclusive There was an association between Exchange rate regimes and Growth. While, but then for each exchange rate regimes the strength is different.	Sample size and time period was small; there is no reason for the behaviour of <i>de facto</i> exchange rate
Dubas et al. (2005)	From 1960 to 2002, total sample 180 countries	Considered as <i>de facto</i> versus <i>de-jure</i>	Used a Random-effects and panel regression;	Did an estimation of Random-effects	Results were positive When comparing with <i>de facto</i> floater with <i>de facto</i> fixers on average it has 1% lesser growth; Both <i>de-jure</i> floaters and <i>de facto</i> fixers grow at 1 level, while <i>de-jure</i> and <i>de facto</i> floaters 12% above. For non-industrialized countries the conclusions are significant.	There was no checking of diagnostics either robustness. Along with the theory many variables also not reported.
Edwards and Levy-Yeyati (2003)	From 1974 to 2000, total of 183 countries were taken	Applied a <i>de facto</i> classification	Applied a Pooled regression	Ordinary Least Squared	It has a negative relation While compared with flexible it had Lower growth under fixed regime.	Questioned; Is growth equation good or Other policy factors?
Eichengreen and Leblang (2003)	From 1880 to 1997, sample was 21 countries	<i>De jure</i>	Used a Real per capita growth analysis	Applied a panel of Dynamic and IV way estimators	It was negative For faster growth there is a string association with flexible exchange rates	<i>De-jure</i> classification and sample selection; weak robustness
Garofalo (2005)	From 1861 to 1998 only on Italy	<i>De facto</i>	Applied a Simple regression model	For endogeneity Ordinary Leas Squared and 2Stage Least Squared are correct	Inconclusive Under soft peg either managed float the growth rate is highest	Same; it found weakness in robustness check; another problem is classification measures.
Ghosh et al. (1997)	1960 to 1990: 145 countries	Categorized by <i>de jure</i> supplement method,	Descriptive analysis	Compared across the means of exchange rate	Their results were Inconclusive. Under floating regime it was	Their analysis was Unconditional: findings

Study	Data and period of sample(s)	Exchange Rate arrangement	Model used in their study	Method	Outcomes with Peg and Growth	Problems
		changes in the frequency parity on-floating regimes.		regimes and standard deviations.	Marginally higher growth. In case of soft or managed float growth was showed highest	shows on effects of exchange rate regimes on productivity was no proper evidence. The effect on productivity was assumed only causal relationships.
Huang and Malhotra (2004)	From 1976 to 2001, out of 30, 12 from developing and 18 from developed countries	Classification method was de-facto	Applied a Panel regression	Ordinary Least Squared	Inconclusive and no relation In terms of growth in developing economies, fixed and managed float outperform the others; in case of developed economies, no relationship revealed	Growth framework was weak and there were certainly not checked their robustness
Husain et al. (2004)	From 1970 to 1999, total of 158 countries	De-jure method	Applied a Pooled regression;	Ordinary Least Squared	Inconclusive Regarding growth, there is no harm from Pegs, but there is no deliverance in flexible rates	Same; it found weakness in robustness check; another problem is classification measures.
Levy-Yeyati and Sturzenegger (2002)	From 1974 to 2000 and total of 183 countries	Used a <i>de facto</i>	Applied a pooled regression;	To accurate the endogeneity: Ordinary Least Squared; 2Stage Least Squared.	Negative and no relation Under developing countries it was Slower growth; underdeveloped countries there is no association.	Questioned; Is growth equation good or Other policy factors?
Moreno (2000 and 2001)	From 1974 to 1999: Taken of 98 emerging countries and countries of East-Asian	Applied method of <i>de facto</i>	Descriptive analysis	Compared across the means of exchange rate regimes and standard deviations.	Results were positive. Under higher growth from both studies it was defined as a peg by 1, 1 p.ps and 3 p.ps correspondingly. By considering survivor bias, the differences narrows.	Still investigation was Unconditional
Mundell (1995)	1947 to 1993: USA, Japan, Canada, EC, and other Europe	Considered as, general floating and general fixing of sub-periods.	Descriptive analysis	They have taken an average growth rates among two sub-periods	It was found a positive relation. It was measured as a higher growth under generalised peg.	Problem raised from the Unconditional examination
Stockman and Baxter (1989)	From 1946 to 1984, taken as a sample of 49 countries	Considered as, general floating and general fixing of sub-periods.	Descriptive analysis	Taken, one is standard deviations and other one is averages.	They found there was no effect. It was also showed that no systematic relationship between system of exchange rate and real aggregates.	The problem was with the Unrestricted examination

The main objective of this present analysis was to summarise the main discussions towards which type of relation does exchange rate regimes had with economic growth. On the theoretical point of view, there are plenty of ways in which way exchange rate regimes might impact on productivity, investment and trade, growth of output. Most of the theoretical studies on exchange rate effects on growth shows that there is an uncertainty impose from the flexible exchange rate regimes. In case of policy uncertainty reduction under exchange rate, it provides growth environment and output effect. At the time of external shocks, it doesn't give adjustments.

Many empirical studies on reviews hardly reached to a conclusion. There are many groups has did observation. Out of that, one of the group came with pegged regimes stimulates growth, in case of flexible regimes doesn't have. One more group given opposite conclusions. Yet another group of studies did not come up with conclusive results. Some groups came with the measurement errors such as classification of regimes (Struzegger and Levy-Leyati, 2002). In the study done by Du and Zhu (2001), divergences were found in measuring exchange rate uncertainty or sampling bias found by Hung and Malhotra (2004). Another study was done by Bleaney and Francisco (2007) majorly focused exchange rate parameters but unable to control countries characteristics, even by applying framework of growth. On endogeneity point of view not yet all treated well, in many cases repeatedly used inappropriate instruments in the approach. A few studies paid only attention towards the context of monetary regimes. The empirical analysis study done by Du and Zhu (2001) shows that many empirical studies differ in a number of ways. For instance, it is not proper for countries to use same as earlier methods, which was used their countries. For this type of issues, time periods and different methods are required.

The overall evaluation on the literature examined in the case of growth and exchange rate regime relationship is given by Goldstein (2002), his study might be useful in two ways; first is to find how a nominal variable affect the growth, secondly, exchange rate regimes not affected in the long-run growth.

3. Data and variable definitions

The annual sample period from 1993-2012 is used. For model specifications, the data from the time period 1993 to 2012 is collected. The data is collected to analysing the impact of exchange rate regimes on the growth of BRICS countries.

Table 2. *Definitions of Variables & Sources*

Variables	Definitions and Sources
%ΔGDP	Rate of growth of real GDP (WDI)
GC	Government consumption to GDP ratio (WDI)
INGDP	Natural logarithm of initial real GDP (WDI)
INVTGDP	Ratio of Investment to real GDP (WDI)
TOP	Openness ration of the sum of the exports and Imports to real GDP (WDI)
POP	Natural logarithm of total population (WDI)
TOTI	Terms of trade: the ratio of the price exports to price of imports (WDI)
π	Annual percentage change in the Consumer price index (WDI)
PEGGED	A binary variable takes the place 1 if a country has a Pegged, takes the value 0 if a country has Non-Pegged.
INFPEGGED	An interaction variable that consists of inflation and pegged

4. Econometric issues and methodology

The following section 4.1 deals with the theoretical framework and Growth model building.

4.1. Theoretical framework and growth model

In this study, a simple growth model is applied to describe the effects of exchange rate regimes on growth. Therefore, growth model is based on:

$$\% \Delta GDP_{i,t} = \delta GDP_0 + \phi INVTGDP_0 - \partial GC_0 + \infty POP_0 + \epsilon_{i,t} \quad (1)$$

Where, $\% \Delta GDP_{i,t}$, the annual rate of GDP growth, GDP_0 , the natural logarithm of initial GDP, $INVTGDP_0$, the initial ration of investment to real GDP, GC_0 , the initial ratio of government consumption to real GDP, POP_0 is the natural logarithm of total population and $\epsilon_{i,t}$ is the error term.

The effects of exchange regimes on growth is explained using a five-year average panel model. The sample includes five BRICS countries over the period 1993-2012.

The baseline growth regression equation is formed as the following:

$$\% \Delta GDP_{i,t} = \beta_0 + \beta_1 GDP_0 + \beta_2 INVTGDP_0 + \beta_3 GC_0 + \beta_4 TOP_0 + \beta_5 POP_0 + \beta_6 TOTI_0 + \beta_7 PEGGED_{i,t} + \beta_8 INF_0 + \beta_9 INFPEGGED_0 + \epsilon_{i,t} \quad (2)$$

According to the equation (2) the five-year average rate of real GDP growth ($\% \Delta GDP_{i,t}$) for country I ($i = 1, 2, \dots, 5$) over time period t , with $t = 1993-1997, 1998-2002, 2003-2007$ and $2008-2012$ depends upon several additional control variables. GDP_0 , the initial GDP, and is expected to have a negative sign (conditional convergence). Initial GDP is to control the conditional convergence. It is initial a relation of investment to real GDP as higher investment rates leads to higher economic growth. $INVTGDP_0$ is the initial ratio of investment to real GDP, and its coefficient is expected to have a positive sign since higher investment rates leads to higher economic growth. GC_0 , the initial ration of government consumption to real GDP. An increase in growth of government consumption is expected to decrease GDP growth. Initial ratio of government consumption (GC) to real GDP has negative and significant influence on growth rate. GC mostly includes recurrent type of expenditure and therefore it does not add to the capital stock. TOP_0 , the initial rates of openness to trade. It is the ratio of the sum of export and import to GDP. It is expected to have a positive relationship with economic growth. POP_0 , represents the natural logarithm of initial total population, and is expected to have positive sign. $TOTI_0$, the initial terms of trade, and it is measured as the ratio of a country's price of exports to its price of imports. It is expected to have a positive sign. INF_0 is the initial percentage change in inflation, and it is expected to be a negative relationship with GDP growth based on the money demand and money supply equation in previous section. $INFPEGGED_0$, is an interaction variable that captures the trade-off between growth and inflation under the proper exchange rate regime. Finally, $PEGGED_{i,t}$ is a binary variable that proceeds the value 1 if a country adopts a pegged exchange rate regime, and the value is 0 when it has classified as a non-pegged exchange rate regime. In this section, an observation requires a time span of total four years for peg is categorized as fixed in a five-year panel, based on the Jay C. Shambaugh regime

scheme. PEGGED, the main variable observes the impact of currency policies on economic growth.

5. Econometric issues, model estimation, and empirical results

The following section divided into three sub-sections. 5.1 explains the Unit root test analysis. Section 5.2 Empirical Findings of Growth Performance.

5.1. Unit root test analysis

The following Tables 3 and 4 briefly shows the unit root results and discussion as follows.

Table 3. Summary of unit root test results stationary at level

Variables	LLC	IPS	Fisher-ADF	Fisher PP
INF	-4.169(0.000)	-4.200(0.000)	35.648(0.000)	31.837(0.000)
POP	-12.80(0.000)	-5.997(0.000)	52.343(0.000)	122.50(0.000)
%ΔGDP	-6.518(0.000)	-5.843(0.000)	49.161(0.000)	61.34(0.000)

Source: Author's calculation.

Table 4. Stationary at 1st difference

Variables	LLC	IPS	Fisher ADF	Fisher PP
GC	-7.196(0.000)	-7.654(0.000)	67.986(0.000)	87.034(0.000)
INGDP	-5.476(0.000)	-5.458(0.000)	45.015(0.000)	66.008(0.000)
INVTGDP	-8.364(0.000)	-8.407(0.000)	75.268(0.000)	136.00(0.000)
TOTI	-0.853(0.196)	-3.460(0.000)	41.974(0.000)	45.434(0.000)
TI (2 nd)	-12.10(0.000)	-13.465(0.000)	124.25(0.000)	86.506(0.000)
TOP	-6.864(0.000)	-6.449(0.000)	54.804(0.000)	111.93(0.000)

Source: Author's calculation.

Unit root test statistics of LLC, IPS, Fisher-ADF, and Fisher-PP test statistics in Table 3 and Table 4. Includes two stages viz, first, at the level and second, with a 1st difference. The above tests have been applied to test stationarity property of the variables used in the present study. A regression using non-stationary variables may provide a spurious result (Granger and Newbold (1974)). Table 4 shows the stationarity at a level for the INF, POP, and %ΔGDP variables and all the remaining got non-stationary variables at level. Other variables like, GC, INGDP, INVTGDP, TI, and TOP got stationary at the difference. If we want to apply co-integration technique, it is important to consider all non-stationary variables should have the same level of the integrating factor. But, according to the results, non-stationary variables have a mixed pattern of integrating level. For, this reason co-integration analysis cannot be applied. Therefore, it has to for different regression equations with and without taking the first and second difference. These estimated results are showed in Table 5.

5.3. Empirical analysis and discussion of the results

Table 5. Estimates of panel regression equation (Dependent Variable %GDP)

%ΔGDP	Coef.	Robust Std. Err.	Z	P> z	[95% Conf.	Interval]
INGDP	-2.306332	.4004161	-5.76	0.000	-3.091133	-1.521531
INVTGDP	.0300859	0.846913	0.36	0.722	-.1359061	.1960778
GC	.1678468	.1108678	1.51	0.130	-.0494501	.3851436
TOP	0.792938	.0170854	4.64	0.000	0.458069	.1127806
POP	2.884117	.2770408	10.41	0.000	2.341127	3.427107
TOTI	2.74e.14	1.07e-13	0.26	0.798	-1.83e-13	2.37e-3
PEGGED	-.817878	.9124926	-0.90	0.370	-2.606331	.9705747

%ΔGDP	Coef.	Robust Std. Err.	Z	P> z	[95% Conf. Interval]
INF	.0012872	.0008581	1.50	0.134	[-.0003946, .0029691]
PEGGEDINF	0.262739	0.465062	0.56	0.572	[-.648766, .1174244]
_cons	2.215678	9.575459	0.23	0.817	[-16.55188, 20.98323]
sigma_u	0				Prob>F Chi2 (3)
sigma_e	.21905499				R-sq: 0.9352
Rho	0 (is a fraction of variance due to u_i)				

Source: Author's calculation.

5.3.1. Empirical findings of growth performance

Based on the past studies, there was no consensus on the impact of proper exchange rate regimes on economic growth. Hence, this section investigates whether the exchange rate regimes affect the growth or not. As discussed earlier, the proper exchange rate regime and its effects on growth are explained using the five-year average panel with the country fixed effects model (time dummy variables are included in all regressions). In this section, an observation requires a total of four years for a peg to be categorized as a pegged in the five-year panel, based on the KS regime scheme. The regime dummy PEGGED is the main variable that looks on the impact of currency policies on economic growth. Table 5 represents the empirical findings for the growth performance.

As per the expectation, the initial GDP has a negative and significant relationship with growth rate. It implies that the BRICS countries namely: Brazil, Russia, India, China and South Africa, exhibits conditional convergence, which means that the countries away from the steady state output are growing faster than the countries nearer to the steady state. The initial ratio of investment to real GDP (INVT GDP) had a positive and significant effect on growth rate. It implies that the countries that have started with a high level of investment to real GDP ratio have been growing at faster rate than their counterparts. The initial ratio of government consumption (GC) to real GDP has a positive and significant influence on growth rate. Since GC mostly includes the recurrent type of expenditure, it does not add to the capital stock. Therefore increasing GC is likely to crowd out much needed public expenditure on an infrastructure project. Thus, the increasing initial ratio of GC has a positive impact on growth rate. The trade openness (TOP) has a positive relationship with economic growth. Most of the developing countries have adopted export-led growth strategy resulting in more openness. This result shows that trade openness (TOP) lead towards an improvement in the growth rate of countries under consideration, the effect of openness is also significant. The model also included initial population (POP) and initial ratio of investment to real GDP as these variables indicate initial supply of factors of production. The countries which have reported higher population and high level of investment in base year are expected to grow faster than otherwise. The results indicate that population and initial investment have positive and significant effects on growth rate. The terms of trade (TOTI) variable in the model is likely to capture the effect of external shocks on the domestic economy. It is measured as the ratio of a country's price of exports to its price of imports. The results show that the improvement in this ratio has a positive impact on growth, though the effect is insignificant. The rapid economic growth is associated with a subsequent increase in aggregate demand is likely to result in inflation (INF). According to the money demand and money supply equation for a faster growth of output and lower

growth in money supply, the inflation follows the downward path. The results indicate the same positive relationship between inflation and growth rate, however, it is insignificant. Country under pegged exchange rate regime has negative growth rate (-.81%) than countries under no-pegged exchange rate regime. However, the relationship is insignificant indicating that the different exchange rate regimes (pegged and non-pegged) don't have statistically significant effect on growth rate.

6. Summary and conclusion

This analysis brings several interesting facts on the *de facto* exchange rate regimes followed by the BRICS countries in the late 1990s and the linkage between these regimes on Economic growth performance.

An attempt is made to revisit the relationship concerning exchange rate regimes and economic growth outcomes under the recent financial crisis and external shocks. This chapter included data from BRICS countries, from 1993-2012. This time, span is not covered in the preceding studies and includes both past and present financial turbulences in BRICS countries. This chapter also deals with different classification methods that have led to several studies on exchange rate regime classifications among which most widely used is *de facto* classification systems it was measured by the actual performance of the exchange rate system, conferring to the Jay C. Shambaugh (2003). In accumulation, to avoid breaks in the status of peg due to one-time rearrangements, any exchange rate that had a percentage variation of zero in 11 out of 12 months is measured Pegged. This model is the newest model and focused only at Pegged or Non-Pegged exchange rate regimes effects on Economic growth in BRICS countries.

The analytical results showed, that the Pegged exchange rate regimes are not much associated with better performance in terms of growth. In the growth performance, BRICS countries with Pegged regimes show significantly negative growth. Pegged regimes have significantly (-81%) lower growth in BRICS countries. The impact of Pegged regime on growth increases and the positive link between Pegged regimes and GDP growth can occur through a pegged regime's price stability effect. Countries with Pegged regimes have lower real interest rates since pegged regimes act as an anti-inflationary tool for monetary policy makers. Thus, low real interest rates lead to an increase in investment, and in the end, a high level of investment leads to higher levels of economic growth. Moreover, by adopting a pegged regime can promote trade for BRICS countries and lead to an increase in economic growth.

In many developing countries, adopting an exchange rate regime is heavily influenced by macroeconomic conditions and goals. Based on the empirical findings made in the research, a pegged exchange rate regime arrangement should be the preferred policy option for the BRICS countries that chose to sustain price stability as a key macroeconomic goal. Moreover, pegged exchange rate regime may be the optimal policy option for BRICS countries who want to pursue export-oriented strategies to increase economic growth.

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